TECHNICAL/REGULATORY GUIDELINES

TECHNICAL REQUIREMENTS

FOR

ON-SITE THERMAL DESORPTION

OF

SOLID MEDIA CONTAMINATED WITH

HAZARDOUS CHLORINATED ORGANICS

-FINAL-

September 18, 1997

Prepared by
The Interstate Technology and Regulatory Cooperation Work Group
Low Temperature Thermal Desorption Work Team

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ABOUT ITRC

Established in 1995, the Interstate Technology & Regulatory Council (ITRC) is a state-led, national coalition of personnel from the environmental regulatory agencies of some 40 states and the District of Columbia; three federal agencies; tribes; and public and industry stakeholders. The organization is devoted to reducing barriers to, and speeding interstate deployment of, better, more cost-effective, innovative environmental techniques. ITRC operates as a committee of the Environmental Research Institute of the States (ERIS), a Section 501(c)(3) public charity that supports the Environmental Council of the States (ECOS) through its educational and research activities aimed at improving the environment in the United States and providing a forum for state environmental policy makers. More information about ITRC and its available products and services can be found on the Internet at **www.itrcweb.org.**

DISCLAIMER

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In addition, the group would like to thank representatives of ITRC member states and federal agencies who provided thoughtful comments on the draft documents. Written responses were received from the states of California, Colorado, Florida, Idaho, Illinois, Louisiana, Massachusetts, Nebraska, New Jersey, New York, Ohio, and Washington.

Special appreciation is extended to Mr. Chris McKinnon of the Western Governors' Association for his support throughout the writing of this document.

EXECUTIVE SUMMARY

In 1994, the Western Governors' Association convened a meeting of western regional regulators to discuss ways to increase cooperation among states on the review, permitting, and evaluation of promising new remediation technologies. This group, the Interstate Technology and Regulatory Cooperation Work Group (ITRC), has since been expanded to states outside the region and includes federal, industry, tribal and public advisors as well.

The ITRC Low Temperature Thermal Desorption (LTTD) Work Team previously developed a document which blends diverse state technical requirements for a proven technology, low temperature thermal desorption, used for treatment of nonhazardous soils. The LTTD Work Team considered requirements from nine states to develop their draft document and circulated the document for review, comment and concurrence to all member states of the ITRC.

The work team expanded its scope to address technical requirements for use of thermal desorption on solid media contaminated with hazardous chlorinated organics. Using the first document as a template for the second, requirements for chlorinated organics were "layered" onto the original text to address some of the more complex issues of treating hazardous wastes. All ITRC member states, as well as interested stakeholders and tribal and federal partners were asked to review and comment on these requirements. The team discussed and integrated many of the comments into the final requirements. This document will now move through the ITRC Concurrence Process to determine the degree of concurrence by ITRC member states on the technical and regulatory guidelines presented within this document.

In keeping with the full ITRC, the LTTD Work Team views stakeholder involvement as a key element, when selecting new technologies for the cleanup of contaminated sites. The Work Team has adopted, in principal, the concepts put forward in "A Guide to Tribal and Community Involvement in Innovative Technology Assessment", developed by the participants o the DOIT Tribal and Public Forum on Technology and Public Acceptance.

In producing this product, the general goals of the LTTD Work Team were:

- to produce a model set of technical requirements which would serve as a format for states;
- to improve market conditions for thermal desorption technology providers by providing a degree of consistency in technical requirements;
- to further the process of interstate cooperation directed toward enhancing implementation of innovative technologies;

Thermal desorbers remove organic constituents from solids by raising the temperature of the contaminated material to a sufficiently high level to effect contaminant volatilization and transfer to a gas stream. Technical requirements focus on achieving contaminant removal, fugitive emissions control, mechanical operability of the primary treatment equipment and efficient fuel combustion (where appropriate).

This document specifies minimum technical requirements for the permitting/approval to operate thermal desorption. The requirements presented in this document are directed toward relatively

small, short term, on-site projects as opposed to permanent treatment, storage and disposal (TSD) facilities. Although the document may touch on some regulatory requirements regarding hazardous waste, it is **not intended to summarize or interpret existing state or federal regulations**.

It is important to note that state regulations may be more restrictive than the minimum technical requirement included in this document and that compliance with those more restrictive regulations is required unless a specific waiver pursuant to CERCLA or some other state statute is involved. Therefore, approval of the use of a thermal desorption unit at a site in one state should not be construed as approval to use the technology at another site in either the same or a different state.

This document has been developed for units used for the treatment of material contaminated with hazardous substances, as well as hazardous wastes which have been assumed to be subject to Resource Conservation and Recovery Act (RCRA) Part 264, Subpart X requirements. For purposes of establishing minimum technical requirements, some technical requirements have been drawn from Subpart O. **However, this document does not attempt to address whether any particular thermal desorption unit/or afterburner is classified as an incinerator.** That determination, along with associated requirements, will be made by individual states and states are still free to regulate a unit under Subpart O.

Technical requirements in this document are provided for the following areas:

- Pre-treatment Sampling
- Feed Soil Limitations
- Treatment Verification Sampling
- Soil Handling and Stockpiling
- System Operating Requirements
- Process Monitoring
- Automatic Shutdown
- Proof of Process (POP) Performance Testing for Air Pollution Control Systems
- POP Testing Frequency for Units Treating Contaminated Media
- Emissions Monitoring
- Water Discharge Monitoring
- Record Keeping
- Quality Assurance/ Quality Control
- Health and Safety
- Cost and Performance Reporting Requirements

On some sites, states may choose to go beyond this set of requirements. It is the responsibility of operators to find out from regulators whether there are additional or alternate requirements applicable; and it is in the states' best interest to allow variances from these technical requirements based on specific technology applications. Variances also should be considered to allow for the use of appropriate alternative sampling or analytical methods.

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TECHNICAL REQUIREMENTS FOR ON-SITE THERMAL DESORPTION OF SOLID MEDIA CONTAMINATED WITH HAZARDOUS CHLORINATED ORGANICS

1.0 INTRODUCTION

1.1 Scope of Document

This document deals with the treatment of solid media contaminated with hazardous chlorinated organics such as chlorinated solvents, chlorinated pesticides, and polychlorinated biphenyls (PCBs) through the application of thermal desorption technologies. The requirements presented in this document are directed toward relatively small, short term, on-site projects as opposed to permanent treatment, storage and disposal (TSD) facilities. For purposes of the document, small, short term projects will be regarded as projects which process about 20,000 cubic yards or less of contaminated material and operate on-site for roughly six months to one year. Because of the wide range of variations from state to state, this document does not address cleanup criteria for soil, water, air or waste classification sampling requirements.

This document has been developed for units used for the treatment of material contaminated with hazardous substances, as well as hazardous wastes which have been assumed to be subject to Resource Conservation and Recovery Act (RCRA) Part 264, Subpart X requirements. For purposes of establishing minimum technical requirements, some technical requirements have been drawn from Subpart O. **However, this document does not attempt to address whether any particular thermal desorption unit and/or afterburner is classified as an incinerator**. That determination, along with associated requirements, will be made by individual states and states are still free to regulate a unit under Subpart O.

In addressing areas of agreement among states, the Low Temperature Thermal Desorption (LTTD) Work Team has chosen to lay out technical requirements, as opposed to guidance or recommendations, for implementation of thermal desorption because it is a fairly well developed technology. In keeping with the objective of providing requirements, the word "shall" is used throughout this document, rather than softer words such as "should."

The focus of this document is on-site treatment using thermal desorption processes. In instances where waste is accepted from additional sites, more emphasis must be placed upon waste analyses prior to treatment to insure that the waste can be effectively treated by the unit and that the wastes placed in the unit do not react with each other.

1.2 Permitting/Approval

This document specifies minimum <u>technical</u> requirements for the permitting/approval to operate thermal desorption units. Although the document may touch on some regulatory requirements

regarding hazardous waste, it is not intended to be a regulatory requirements document. It does not provide details on the applicability of various state and federal hazardous waste regulations to thermal desorption. Since states must administer the regulations that exist in the particular state where the application of this technology is desired, it is strongly recommended that these issues be discussed with state regulators early in the planning process. Many states have opted to obtain authorization from the Environmental Protection Agency (EPA) to administer hazardous waste programs in lieu of the federal RCRA program. To obtain authorization, states have had to adopt rules, regulations and/or standards that are equivalent to RCRA. For example, one such requirement is that no person shall treat, store or dispose hazardous waste without a permit. However, specific exclusions are afforded and some states, through institution of state cleanup programs, have opted to exclude remediation projects from hazardous waste permitting.

For sites that are on the National Priority List (NPL) under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), no administrative requirement exists to obtain a permit; however, in conjunction with the finalization of a record of decision, all federal, state and local applicable or relevant and appropriate requirements (ARARs) must be identified and addressed. While in some states a hazardous waste permit may be required, clearly the importance of understanding the regulatory requirements associated with a site cannot be underestimated.

It is important to note that state regulations may be more restrictive than the minimum technical requirements included in this document and that compliance with those more restrictive regulations is required unless a specific waiver pursuant to CERCLA or some other state statute is involved. Therefore, approval of the use of a thermal desorption unit at a site in one state should not be construed as approval to use the technology at another site in either the same or a different state.

Because there are many types of thermal desorbers (e.g., indirect vs. direct fired units) and because there are many different methods for handling desorbed contaminants by air pollution control (APC) systems (e.g., carbon absorption units v.s. afterburners) many state and federal regulations could be interpreted by various states to apply to a particular system. There are federal regulations that apply to hazardous waste treatments which are similar to thermal desorption; however, none of these treatments truly fall into the class of thermal desorber treatment units. Subpart O of the Federal Regulations applies to incineration of hazardous waste. Some states may regard certain thermal desorption units and/or afterburners as incinerators and therefore require compliance with Subpart O. Subpart AA applies to process vents where mechanisms similar to those used in thermal desorption are employed. The types of activities specified in that regulation do not include thermal desorption of contaminated media. Nevertheless, some states still may require compliance with Subpart AA provisions for thermal desorption units.

1.3 Background

The legal and regulatory uncertainties surrounding the cleanup of waste sites discourage the testing and use of innovative technologies, as well as innovative applications of accepted technologies. Technology developers have difficulty gaining regulatory approval for the use of new technologies.

Their difficulties are compounded by the requirement for developers to demonstrate a technology's performance in each state targeted for technology deployment.

In response to this concern, the Western Governors' Association convened a meeting of western regional regulators during the summer of 1994 to discuss ways to increase cooperation among states on the review, permitting, and evaluation of promising new remediation technologies. This group, the Interstate Technology and Regulatory Cooperation (ITRC) Work Group, has been expanded to states outside the region and includes federal, industry, tribal and public advisors as well. The ITRC is now in its second year and is continuing in its work to recommend mechanisms to be incorporated into state policy to facilitate interstate cooperation, in order to shorten the time it takes technologies to go from demonstration to widespread application.

In 1996 the LTTD Work Team, consisting of regulators from California, Florida, Illinois, New Jersey, New York and the United States Environmental Protection Agency (EPA), developed a consensus based set of technical requirements for use of thermal desorption in the treatment of soils contaminated with petroleum/coal tar and manufactured gas plant wastes. That document is being circulated for individual state sign-off and letters which indicate levels of acceptance by all states of the ITRC.

The LTTD Work Team has expanded the group to include representatives from California, Florida, Illinois, New York, Tennessee, the Environmental Protection Agency, the Department of Energy, the US Army Corps of Engineers, private industry and stakeholders. The team has expanded its scope to address technical requirements for use of thermal desorption on solid media contaminated with hazardous chlorinated organics; those requirements are presented in this document.

1.4 Assumptions

In preparing this document, the LTTD Work Team used the following "basic assumptions".

- The LTTD group elected to produce baseline technical requirements which should be followed for all thermal desorption applications. Because of the wide diversity of thermal treatment technologies, the group feels it is not feasible to establish a detailed test plan appropriate for all sites.

- These technical requirements were developed to provide stakeholders (including vendors) with some degree of predictability and consistency of technical operating requirements from state to state. However, individual state's regulatory requirements have not been evaluated and states reserve the right to go beyond these requirements, but should have a rationale for doing so.

- Alternatives to these requirements may also be acceptable, on a case specific basis, but there should be a technical basis for the alternative.

- Because of the wide variability among states, the technical requirements do not include any emission criteria for air or cleanup criteria for soil or water.

- The term "hazardous" is as defined by the RCRA, but for purposes of this document will include Toxic Substances Control Act (TSCA) regulated PCBs..

1.5 Status of Thermal Desorption Use for Hazardous Waste

The use of thermal desorption has advanced to the point where many states have approved/permitted some thermal desorbers for hazardous waste treatment. The earliest documented, full-scale use of thermal desorption for the treatment of organic hazardous waste constituents was at a Superfund site in Maine in 1987. Since that time, various embodiments of the technology have been used for the treatment of chlorinated organic chemicals impacted media. Organic contaminants may range from high volatility solvents such as trichloroethylene (TCE); to intermediate boiling compounds such as organochlorine pesticides; to extremely low volatility compounds such as PCBs, pentachlorophenol, and dioxins. Extensive pilot scale and treatability study experience has demonstrated that chlorinated organic chemicals can be effectively removed from soils and similar solid media to very low residual levels [1]. Solid matrices demonstrated include soil, sediments, lagoon sludges, process filter cakes, and similar solids. More recent experience has been gained with batch fed units treating both geologic and man made debris materials.

To date, the majority of the full scale operating experience with thermal desorbers in hazardous waste service has been at Superfund sites or at sites managed under state "Superfund" programs. This trend developed because these programs contain provisions for expedited operating approval which facilitate the performance of cleanup activities, even when operating standards and permit doctrine for the new technology is not yet developed.

Two classes of thermal desorber units have emerged: direct and indirect fired units. In virtually all cases, through the careful selection of design and operating conditions that are appropriate for the specific chlorinated organic chemicals in the waste matrix, the contaminant removal efficiency is the same for these fundamentally different thermal desorption approaches.[2] Technical considerations for these units are presented in Section 1. 5 Special Considerations for Treatment of Hazardous Waste.

A review of results from example, full-scale thermal desorption operations can highlight operations and cost issues and help guide decision makers to achieve the proper balance. Several sites,

[1] Ayen, Palmer, and Swanstrom, 1994.

[2] Giese, R.G., June 23, 1992.

contaminated with chlorinated organic chemicals, have been cleaned up using direct-fired thermal desorbers with production capacities as high as 50 tons/hour. At sites where the contamination largely consisted of chlorinated alkanes or organochlorine pesticides of low concentration, emissions control has been achieved using either an afterburner with moderate temperature and residence time or activated carbon adsorption. The choice of whether to use carbon adsorption or an afterburner for the emissions control device depends upon specific emissions limitations criteria for the site, as well as concerns over the potential for formation and emission of undesirable air pollutants.

At similar sites where control specifications were more rigorous, a 15 ton/hour indirect fired unit has been used with a conservatively designed and operated afterburner. On multiple sites contaminated by PCBs, indirectly heated thermal desorbers have been used with secondary condensation and carbon recovery type gas systems. Table 1-1 Full Scale Thermal Desorption Experience for Chlorinated Hydrocarbons summarizes full scale experience, to date, for thermal desorption units operating on materials impacted by chlorinated organic chemicals.

1.6 Special Considerations for Treating Hazardous Waste

Thermal desorbers remove organic constituents from solids by raising the temperature of the contaminated material to a sufficiently high level to effect contaminant volatilization and transfer to a gas stream. Various thermal desorption technologies employ differing combinations of temperature, time and mixing to perform this transfer. Wide ranging soil characteristics in combination with contaminant properties make it very difficult to impose meaningful requirements on this key operational step. Technical requirements are highly specific to the particular approach and focus on
achieving contaminant removal, fugitive emissions control, mechanical operability of the primary treatment equipment, and efficient fuel combustion (where appropriate).

Two classes of thermal desorber units have emerged: direct and indirect fired units. In either approach, heat from the combustion of fuel in burners is applied to the soil to evaporate the organic chemical and remove it into a gas stream. In a direct fired unit, the burner gases are intimately mixed with the waste and/or waste gases. The direct fired unit can be operated either to completely oxidize the desorbed organic chemical or to recover part or most of them from the gas stream.

In an indirect fired unit, the heat is conducted to the waste through metal walls or with a medium such as heated gas. Recovery of the contaminant is much simpler for an indirect fired unit, because the high volume combustion gas is not present and only the small volume of contaminant and process gas must be managed in the recovery system. Furthermore, control of the oxygen concentration can be readily effected, minimizing or eliminating oxidation of the organic material and allowing its complete recovery. Recovery units require off-site disposal or recycling of the concentrated organic chemicals.

Two significant differences exist between the direct and indirect fired units: 1) the degree to which air emissions can be controlled and 2) their operating production rate and corresponding cost of operation. When large volume media such as soil is subjected to thermal desorption treatment, the

heat input required to remove the organic contaminants yields a very large volume of combustion gases from the burners. Very high heat rates and resulting production rates result from mixing the burner gases with the contaminated soil in a direct fired unit. When the gases are mixed with the hazardous waste or desorbed waste gases, then the entire gas stream must be controlled prior to emission to the air. If EPA technical specifications and guidance are followed for these control devices, they can become extremely expensive to build and operate. However, since concern for air emissions increases with the introduction of chlorinated organics and possibly even dioxin precursors into the thermal desorber, technical specifications for management of air emissions (e.g., complete destruction of chemicals, scrubbing and filtering of exhaust gases to remove the products of combustion) cannot be relaxed.

TABLE 1-1. Full Scale Thermal Desorption Experience for Chlorinated Hydrocarbons

UNIT	CONTAMINANTS	STATE	TONNAGE
Indirect fired Thermal Desorption Unit (TDU) with condenser and carbon	PCB PCB PCB PCB PCB Organochlorine pesticides Chloraniline derivative Organochlorine pesticides PCE Chlorobenzene TCE, Dichloroethene (DCE) Pesticides TCE TCE, Dichloroethane (DCA)	MA SC NY IL KY OH MI NC NY NJ PA ID NC CA	50,000 60,000 42,000 13,000 20,400 19,000 8,000 19,000 2,000 6,500 18,000 500 12,000 3,000
Indirect fired TDU with afterburner	TCE	OK	1,000
Direct fired TDU with condenser and carbon	Chlorinated Solvents Chlorinated Solvents Chlorinated Solvents Chlorinated Solvents Chlorinated Solvents Organochlorine pesticides	ME NH NJ MA NJ AZ	18,000 8,000 18,000 6,500 4,400 50,000
	Chlorinated Solvents	NJ	6,500

Direct fired TDU with afterburner	Organochlorine pesticides	FL	5,200
	Organochlorine pesticides	FL	2,200
	Volatile organic compounds (VOCs)	PA	28,000
	VOCs	NY	6,500
	DDT	GA	3,000
	TCE, PCE	NY	18,000
	Pesticides	WA	14,000

Adapted from Cudahay and Troxler (1993) with additional data from public domain literature.

That is when the indirect fired unit with a low volume gas stream to manage becomes more cost effective while still achieving exceptional control of emissions. Even though the heat rate is much lower because burner gases are separated from the waste and waste gases, the smaller control devices can be operated at high efficiency and low cost. This balance among technical specifications, air emissions, production capacity and cost is significant, and will define the remedy selected for each site under consideration for thermal desorption treatment.

When a thermal desorption unit employs direct firing of the primary, an additional removal mechanism can exist whereby the organic contaminant can be partially or completely oxidized. This improves contaminant removal from the solids at lower treatment temperatures, and can extend the range of applicability of a direct fired unit. In these units, additional technical requirements become significant. Another issue is that certain inorganic constituents when present in the solids (i.e., lead, chrome) can easily be oxidized to increase their toxicity and mobility in the treated solids or residuals, invoking additional technical and monitoring requirements for metals.

For direct fired units, design and operating standards shall be applied to either the primary chamber or the downstream air pollution control system to assure complete combustion of the principle organic hazardous constituents, as well as elimination of the products of incomplete combustion. Significant research and operational experience have confirmed the importance of both minimum technical specifications on the equipment and procedural requirements for its operation to assure a high level of performance in both normal and upset conditions. This experience has shown that, for conventionally designed and operated units, effective operation has been achieved with a minimum gas temperature of 1,800^{o} F at the outlet of the afterburner; for PCBs this minimum temperature has been 2,000^{o} F. Also the residence time for gas in the afterburner is normally maintained for more than two seconds. The carbon monoxide level in the undiluted stack gas has been found to be an easily measured surrogate for DRE. Significant data exist showing that when carbon monoxide is maintained at less than 100 ppm in the stack gas, high DRE is assured. Finally, it is considered standard technique to supply enough excess oxygen to provide efficient combustion and to monitor the oxygen level continuously to assure its adequacy. To ensure high DRE throughout the remedial operations, all of these parameters are verified during the POP test and are also interlocked with the feed system to cause automatic waste feed cutoff if they are out of specification.

Basic safety dictates the importance of strict limitations on the maximum organic material feed rate to these units, Excessive feed rate can overheat the equipment components from heat released during combustion and cause mechanical failure and possible uncontrolled emissions. It is normal practice for the treatment unit designer to determine the maximum organic waste feed rate that is safe. Physical and/or administrative methods to measure and limit the feed rate are then developed and implemented to prevent overheating of the unit during remedial operations. This constraint does not apply to units that have positive measures to prevent combustion in the primary unit (e.g., indirect heated units with gas seals and inerting systems).

When the gas treatment and/or air pollution control systems involve the recovery of the organic contaminant by condensation, carbon adsorption or similar technique, the focus of the technical requirements for this equipment is on air emissions control within state and federal limitations. Issues exist regarding both the preservation of local ambient air quality and the emission of toxic or hazardous air pollutants. Additionally, states may impose requirements for “best” or “maximum” available control technologies for specific air pollutants.

When the gas treatment system involves an afterburner for the destruction of the organic compounds, additional technical requirements become significant. Design and operating standards, that assure complete combustion of the principle organic hazardous constituents and elimination of the products of incomplete combustion, should be applied to the afterburner (or similar component of the air pollution control system). These technical standards involveafterburner operation at very high gas temperatures.

For direct fired units, solids carryover from the primary unit of 20% or more is common. For indirect fired units, 3 to 12 % is common. If the contaminated solids contain certain volatile metals (e.g., lead, arsenic, cadmium), they may be vaporized from dust particles at these high temperatures and may cause air emissions issues as they are difficult to control with the downstream air pollution control devices. Also, APC dust or ashes can exhibit altered metals leachability from oxidation. Both of these issues invoke additional technical and monitoring requirements with respect to metals.

1.7 Special Considerations for Hazardous Waste Units Treating Dioxin/Furan Precursors including Polychlorinated Biphenyls

There are two dioxin/furan issues related to thermal desorption: 1) the possible formation of dioxin/furans during thermal desorption treatment, and 2) the fate of any dioxin/furans created by the thermal desorption system or innate to the impacted media in the thermal desorption system. It is known that well-operated thermal desorption systems can minimize the potential for formation of dioxins/furans. However, during a USEPA SITE demonstration[3] there was evidence that thermal desorption systems can form dioxin/furans under certain conditions.

[3] Roy F. Weston, Inc., December 1992.

Factors causing dioxin formation during this demonstration included long residence times at a temperature of 650^{o} F, existence of chlorinated organics, and addition of ferric chloride to the sediments during dewatering. There are many other factors that impact the creation of dioxin/furans[4], but the full discussion of these factors is outside the scope of this document. (The cited reference is one of many documents that address the dioxin/furan formation issue).

If a site has been contaminated with chlorinated aromatics, there may be small amounts of dioxins/furans in the soil. Because the untreated soils may contain many interfering humic and chlorinated aromatic organics, the dioxin/furans analytical detection limits may be raised to a point above the dioxin/furan soil concentrations. Consequently, these dioxin/furans may be detected in the soil only after treatment. In this case, post-treatment detection of dioxins/furans does not mean that dioxin/furans were formed as a result of thermal desorption treatment, but rather that the interfering compounds have been removed from the soil through treatment and thus the detection limits are much lower.

Regardless of the thermal desorption unit's operating temperature, there is evidence that dioxin/furans contamination is removed from soil to a certain degree. It is believed that co-distillation or co-volatilization of the dioxin/furans with the soil moisture and/or contaminants is the mechanism. As expected, the higher the thermal desorption operating temperature the greater the dioxin/furan removal from the soil. Temperatures of 900^{o} F to 1100^{o} F have been identified as the requirement to actually remove dioxin/furans from contaminated soil to the part per trillion (ppt) level.

Whether occurring in the soil or formed in the process, dioxins/furans are usually collected and concentrated in the air pollution control (APC) system. Dioxin/furans frequently "ride" with small particulates into the APC system. Thus, the filter/baghouse dust may have detectable levels of dioxin/furans. Further, if there is sufficient organic contamination to have an organic phase from the condensers and/or scrubbers, detectable dioxin/furans may occur, since dioxin/furans are much more soluble in organics than in water. Carbon adsorption is frequently used to treat both the gas and aqueous residuals before discharge or reuse, since carbon adsorption has been found to be very effective treatment for dioxin/furans and other heavy organic contaminants. To insure that unacceptable levels of dioxin/furans are not emitted to the atmosphere, stack gas sampling for dioxin/furans should be considered, if dioxin/furan precursors such as chlorinated aromatics exist in the feed media. (See Section 7.3 of this document).

[4] Ruud and Kees, 1995, p. 1425.

It must be noted if the feed material is derived from materials which contain more than 50 mg/kg PCBs, TSCA regulations will apply. For federal NPL sites, no TSCA permit is required, however, substantive compliance is required. For state lead sites which contain more than 50 mg/kg PCBs, a TSCA permit is required.

1.8 The Need for Flexibility and Variances for Technical Requirements

The LTTD group recognizes that on some sites, states may choose to go beyond this set of requirements. It is the responsibility of operators to find out from regulators whether there are additional or alternate requirements applicable; and it is in the states' best interest to allow variances from these technical requirements based on specific technology applications. Variances also should be considered to allow for the use of appropriate alternative sampling or analytical methods.

In order to provide flexibility in the technical requirements, variances for alternate sampling, analytical, or monitoring methods may be appropriate if:

1. the method has previously been used successfully under similar site conditions, as documented by a regulatory agency; or

2. the method has been tested successfully by an independent, nonregulatory verification entity; or

3. the method is approved by the agency, based upon site specific conditions or technology modifications; the following criteria should be considered:

    a. waste stream homogeneity (e.g., verification sample frequency could be decreased for a homogeneous waste stream where large volumes of material are to be treated and increased for a heterogenous waste stream);

    b. contaminant concentration in waste stream (e.g., verification sample frequency could be decreased for a waste stream that is uniformly contaminated);

    c. automatic feed cutoff/ shutdown conditions (e.g., shutdown condition based on exit temperature could be modified based on a higher verification sample frequency);

    d. receptor proximity (e.g., fugitive dust control requirements could be relaxed based on receptor proximity).

1.9 The Need for Public Involvement

The LTTD Work Team recognizes the need for stakeholder involvement when selecting new technologies for the cleanup of contaminated sites. In keeping with the full ITRC, they have adopted the concepts in principal put forward in "A Guide to Tribal and Community Involvement in Innovative Technology Assessment," developed by the participants of the DOIT Tribal and Public

Forum on Technology and Public Acceptance. This guide clearly points out the desire and need for "meaningful community involvement" at the site implementation level.
Although emphasis is placed on public and tribal involvement at the site specific level, technology developers need to be aware of the types of information the community will require for their decision making process. The guide can be used as a "checklist" by technology developers and regulators. Examples of concerns which can be considered in a generic sense include noise levels, air emissions, risk to the public, permanence of the remedy and cost.

1.10 Cost and Performance Reporting Requirements

The ITRC has adopted the "Guide to Documenting Cost and Performance for Remediation Projects," developed by the Federal Remediation Technologies Roundtable, as a model to standardize cost and performance reporting. The LTTD group further recommends that the data and information found in the EPA Cost and Performance Report for the TH Agriculture & Nutrition Company Superfund Site is appropriate for use in documenting applications of thermal desorption. Routine applications of thermal desorption may not need to be documented using the cost and performance format. The EPA Technology Innovation Office has agreed to determine which thermal desorption applications need to be documented using the cost and performance format. A standardized outline of a cost and performance report for thermal desorption is provided in Appendix C of this report.

2.0 PRETREATMENT SAMPLING

2.1 Sample Parameters and Analytical Methods

For purposes of this document, the objective of pretreatment sampling is to adequately test the waste and describe the waste to provide the expected range of contamination on the site. This information is necessary in order to select the appropriate waste (e.g., soil) for the thermal treatment test runs and to insure that the most heavily contaminated and most difficult to treat samples are selected for the test run. It is assumed that the site has been adequately characterized during a remedial investigation. Therefore, sample frequency requirements are not addressed in this document.

Pretreatment sampling for hazardous solid media contaminated with chlorinated organics shall include the parameters for the contaminant source outlined in Table 2-1. Pretreatment sampling parameters shall also include any additional contaminants of concern associated with the waste. (See Section 3. Feed Soil Limitations for special considerations regarding soil). Sample data collected during an investigation of the site may be substituted for the pretreatment sampling, as appropriate. EPA/ASTM methodologies shall be utilized for analysis of all parameters. Recommended methods for the various sampling parameters are also presented in Table 2-1.

2.2 Sample Quality Assurance/Quality Control (QA/QC)

All QA/QC required by the specified sampling and analytical methods shall be completed. Lab QA/QC summary documentation (including nonconformance summary report[5] and chain of custody) shall be submitted with analytical results. Full QA/QC deliverables as specified by the analytical method shall be maintained and shall be available upon request for at least three years. Ultimate responsibility for QA/QC documentation belongs with the responsible party of a site or the vendor conducting a demonstration. However, the responsible party may contract with another entity, such as an analytical laboratory, to house the actual QA/QC data.

3.0 FEED SOIL LIMITATIONS

The generator of the soil shall certify, based upon site history or previous sampling/characterization, the nature of the material to be treated. If there is any doubt as to the nature of constituents, sampling is required. Soil contaminated with elevated levels of heavy metals shall not be treated unless the emission rate and impact of those metals has been evaluated and found acceptable by the approving authority.

TABLE 2 - 1. Sampling Parameters and Methods of Analysis for Thermal Desorption of Solid Media Contaminated with Hazardous Chlorinated Organics

Contaminant	Analytical Parameters	Analytical Method
Total Petroleum Hydrocarbons (TPHC) **or** Total Recoverable Petroleum Hydrocarbons (TRPH)	HC .PH	SW-846 Method 8015B EPA Method 418.1
lorinated Pesticides	ganochlorine Pesticides and PCBs [1]	SW-846 Method 8080 Gas Chromatograph/Electron Capture Detector (GC/ECD)

[5] Using standard Contract Laboratory Program (CLP) format or equivalent.

	mivolatile Organics (BNAs) [2]	SW-846 Method 8270 Gas Chromatograph/Mass Spectrometer (GC/MS)
lychlorinated Biphenyls	ganochlorine Pesticides and PCBs	SW-846 Method 8080 (GC/ECD)
	mivolatile Organics [2]	SW-846 Method 8270 (GC/MS)
lorinated Solvents	latile Organics [3]	SW-846 Method 8240 (Packed Column) SW-846 Method 8260 (Capillary Column)
	mivolatile Organics [2]	SW-846 Method 8270 (GC/MS)

Table Footnotes

1. Note: Both SW-846 methods 8080 and 8270 can be used for PCBs and pesticides. Method 8080 is often preferred because it achieves lower detection limits and is cheaper than method 8270. However, method 8270 may be preferred if other semivolatile organic contaminants (e.g., polycyclic aromatic hydrocarbons) are present in the source material. Although either method is suitable for pretreatment soil analyses, method 8080 is recommended for treatment verification analyses since lower detection limits are achievable.

2. BNA compounds are base/neutral/acid extractables. This includes polycyclic aromatic hydrocarbon (PAH) compounds.

3. EPA target compound list volatile organic (VO) or priority pollutant VO scans including xylene with a gas chromatograph/ mass spectrometer (GC/MS) library search for the ten highest peaks.

The soil conditions listed below require pretreatment or a test run to ensure the technology will be effective. Either an on-site test run or a representative test run conducted at another site will be deemed sufficient to meet this requirement.

1. soil moisture >35%
2. material > 2" diameter[6]
3. soil has high plasticity [7]
4. soil has high humus content [7]
5. greater than 25% lower explosive limit (LEL) in gas in desorption chamber [8]

4.0 TREATMENT VERIFICATION SAMPLING

4.1 Sample Parameters

Treatment verification sampling for hazardous solid media contaminated with chlorinated organics shall include the parameters outlined in Table 2-1. In addition, any other site specific contaminants of concern for the treated material shall be included in the parameter list. Verification sampling is not required for any contaminants which will be unaffected by thermal treatment, including metals.

4.2 Sample Frequency

In the case of soils, post-treatment soil sampling for full scale operations will require one (1) composite sample for each one hundred (100) cubic yards or one hundred and forty (140) tons of treated soil, using American Society of Testing and Materials (ASTM) method ASTMC702-87. Each composite shall comprise five (5) discrete samples. As an alternative to composite samples, five (5) discrete samples for each one hundred (100) cubic yards or one hundred and forty (140) tons of treated soil may be collected.

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[6] Maximum size of treatable material may be a function of equipment.

[7] The value will be regarded as "high" if the plasticity or humus content is significant enough to impact the efficiency of the treatment unit.

[8] Limitation is included to address explosivity and is not applicable for inert environments. The level of concern is 100,000 ppm for total organic carbon (USEPA, November 1993).

Based upon documented efficiency of the treatment system, the post-treatment sample frequency may be reduced on a case by case basis. This situation may be particularly applicable to situations where the waste is homogeneous and large volumes of waste are to be treated.

Special consideration is required for volatile organics sampling. To minimize loss of volatile contaminants, it may be appropriate to collect volatile samples using specialized sampling techniques such as the sampling method recommended by the state of Illinois[9] and the methanol preservation method soon to be adopted by the state of New Jersey[10]. For sampling during a proof of process performance test (POP), see Section 7.1

4.3 Analytical Methods

The EPA/ASTM methodologies for hazardous constituents presented in Table 2-1 shall be used. For verification sampling, gas chromatography methods with a mass spectrometer detector system are required for analysis of volatile/semivolatile contaminants. Mass spectrometer methods are not required if:

1. contaminant identity is known;
2. the contaminant chromatographic peak is adequately resolved from any other peak; and
3. at least 10% of the sample analyses (minimum of one sample) are confirmed using the appropriate gas chromatograph/mass spectrometer detection system.

4.4 Sample QA/QC

All QA/QC required by the specified sampling and analytical methods shall be completed. Lab QA/QC summary documentation (including nonconformance summary report and chain of custody) shall be submitted with analytical results. Additional minimum requirements shall be specified in the test plan, work plan and site specific QA/QC plan. Demonstration tests require a higher (i.e., CLP) level of accuracy. For POP testing requirements, see Section 7.1.

Full QA/QC deliverables shall be maintained and shall be available upon request for at least three years. Ultimate responsibility for QA/QC documentation belongs with the responsible party of a site or the vendor conducting a demonstration. However, the responsible party may contract with another entity, such as an analytical laboratory, to house the actual QA/QC data.

[9] Ted Dragovich, State of Illinois Environmental Protection Agency, personal communication.

[10] Brian Sogorka, State of New Jersey Department of Environmental Protection, personal communication.

5.0 SOIL HANDLING AND STOCKPILING

Pretreatment soil stockpiles shall be stored on a surface such as concrete or an impermeable liner of appropriate thickness for the contaminants of concern. To minimize volatile emissions and protect worker safety, the stockpile shall be covered (e.g., by a secured plastic cover of appropriate thickness or equally effective spray coating) and may be stored within the confines of a building. At a minimum, the staging area for the stockpiles shall be constructed to prevent surface water and precipitation from entering the area and to collect leachate. All soil stockpiles shall remain covered to prevent the generation of dust. Water spray or equivalent shall be utilized as necessary to prevent dust generation. Monitoring shall be provided to ensure that unacceptable levels of dust generated from the movement and handling of soil do not migrate from the site.

If the material to be treated is regulated as a hazardous waste or debris, then it must be stored in accordance with the 40 Code of Federal Regulations (CFR) 264 or 265 or state equivalent. These requirements include land disposal restrictions (LDR), minimum technology requirements, and corrective action management unit (CAMU) requirements.

Post-treatment soil shall be stored in the same manner as pretreated soil until analytical testing has confirmed that the soil has successfully been treated. A physical barrier, such as a curb or a wall, shall be maintained to separate the pretreatment from the post-treatment stockpiles. All areas shall be restored, to the extent practicable, to preremediation conditions with respect to topography, hydrology and vegetation, unless an alternate restoration plan is approved by the governing agency.

6.0 SYSTEM OPERATING REQUIREMENTS

6.1 Primary Unit Operations

The unit shall be operated within the operating envelope created during site specific test runs conducted to optimize system performance. Operating conditions such as temperature range, residence time and airflow in primary units and air pollution control devices shall be determined during the test runs. Proof of performance (POP) testing shall consist of three runs for each condition.

The test shall be conducted for the worst case contaminant conditions at the maximum material processing rate. If conditions warrant (e.g., wide variation in soil type on site), this test may include separate runs for treatment of differing soil types or media contaminated with hazardous waste. For example, if soil is contaminated with chlorinated solvents, two runs could be required: one with coarse soil and one with fine soil. If any adverse feed soil conditions as listed in Section 3.0 (e.g., high TPHC, high plasticity, humus) exist, soils exhibiting these conditions shall be treated during an appropriate number of test runs.

Test runs at each new site are generally expected, unless a previous site having similar media characteristics, the same constituents of concern, and the same contaminant levels has been successfully remediated, using the same type of equipment. See Section 7.1 for stack testing requirements.

6.2 Air Emission Control Unit Operations.

When treating hazardous waste, an effective air pollution control system is required in order to ensure adequate hydrocarbon, acid gas and volatile contaminant control. To ensure adequate particulate control, a baghouse or equally effective air pollution control device is required. Acid gases may be controlled by using a wet or dry scrubber or by using a coated baghouse. Operating conditions, such as temperature and duration, for air pollution control devices will be determined during the test run, subject to individual state approval.

6.3 Monitoring of Operating Parameters

At a minimum, the following operating parameters shall be monitored and recorded during operation of the unit:

1. exit treated waste temperature;
2. baghouse pressure drop, venturi pressure drop, or drop in liquid/gas ratio;
3. waste feed rate;
4. afterburner temperature (if applicable);
5. exit air temperature from the desorption chamber;
6. an indicator of stack gas velocity (if applicable);
7. flow rate and pH of acid gas scrubber liquor.

Other operating parameters may be required as a result of site and equipment specific conditions.

6.4 Automatic Waste Feed Cutoff /Shutdown Provisions

For continuous feed units, the conditions listed in Table 6-1 shall trigger automatic shutdown of contaminated feed; for batch units, the conditions shall trigger shutdown of the unit. However, other automatic waste feed cutoff/shutdown requirements may be added on a case by case basis, if warrented by equipment design and contaminants of concern.

TABLE 6 - 1. Automatic Waste Feed Cutoff /Shutdown Provisions

Conditions	Initiate Waste Feed Cutoff/Shutdown
1. Primary burner failure	Instantaneous
2. Outlet waste temperature falls below set point which is based on type and amount of contamination, waste type, and test run.	10 minute delay

Conditions	Initiate Waste Feed Cutoff/Shutdown
3. Afterburner temperature (if applicable) falls below set point used in test run.	30 second to 2 minute delay
4. Blower failure or positive pressure at the desorber.	Instantaneous
5. Bag house pressure drop, venturi pressure drop, or drop in liquid/gas ratio (if applicable) outside the operating envelope determined during test run.	Instantaneous
6. Carbon monoxide (CO) in exhaust gas (for units with an afterburner only).	10 minute delay
7. Waste feed rate exceeds approved limit	10 minute delay
8. An appropriate indicator of significant change outside the operating parameter for gas velocity through secondary treatment device.	10 minute delay

6.5 Fugitive Emissions Control

Fugitive emissions control is required and shall be accomplished by maintaining negative pressure in equipment designed to operate at negative pressure. Controls to limit fugitive dust emissions at the treated waste outlet shall be in place. Treated waste shall be moisturized within the enclosed discharge conveyor to minimize dust generation. Emissions of particulates and volatile organics shall be minimized through engineering controls and appropriate handling practices.

7.0 PERFORMANCE TEST AND AIR EMISSIONS MONITORING REQUIREMENTS

From a state's point of view, performance tests results and air emissions levels are major factors in determining whether a process will operate in a manner that is protective of human health and the environment and whether that process can be permitted. This section will focus on performance test requirements, emission monitoring requirements, frequency of monitoring and parameters. Air emissions criteria are not addressed because these are determined by individual states.

7.1 Proof of Process Performance Testing for Air Pollution Control Systems

The minimum control efficiency of the air pollution control system is a technology driven requirement (i.e., what a well-designed, well-operated, well-maintained system will provide.) The measurement of this efficiency has traditionally been in terms of destruction/removal efficiency (DRE) which is defined as the ratio of the amount of contaminant prevented from being released through the stack compared to the amount of contaminant in the feed.

For purposes of this document,

$$\text{DRE} = \frac{\text{Mass of waste IN feed - Mass of waste OUT (at stack)}}{\text{Mass of waste IN feed}} \times 100$$

(% Destruction/Removal Efficiency)

In many cases, the stack emissions after the application of air pollution control equipment are nondetectable. The standard way to deal with this problem is to assume emissions at the detection limit. Unfortunately, the resulting DRE is frequently less than 99.99 % because of a relatively low contaminant input rate. The remedy for this problem has been to spike the untreated waste with contaminants. The concept of adding contamination to the waste to be treated is discouraged for the purposes of this document unless an appropriate nonhazardous surrogate is used, especially since the volume of contaminant used in spiking could exceed the total amount of contamination to be treated.

Therefore, proof of process tests with DREs less than 99.99 % will be deemed acceptable, provided that air contaminants during the demonstration tests are nondetectable using detection limits approved in the demonstration testing program. However, a good faith effort must be used in locating the most contaminated waste. The LTTD Work Team members believe this will satisfy the requirement to prevent releases of hazardous constituents to the air which might pose a threat to human health and the environment as required by 40 CFR 264 Subpart X. The process operating parameters recorded during the demonstration test shall become the operating limits for the equipment.

It should be noted that even if the technology meets the minimum technology requirements presented in this document, states in conjunction with community stakeholders will still require an impact assessment before allowing the unit to be permitted.

A performance test should include sampling and analysis of untreated and treated waste and treatment residuals, such as air pollution control residuals. Sampling of treated and untreated waste and residuals should be concurrent with stack testing (See Section 7.2). Where creation of products of incomplete combustion (PICs) or existence of dioxins/furans is of concern, analysis of dioxins/furans should be considered for all soils and treatment residuals.

Hydrochloric acid emissions must be limited to no more than four pounds per hour or, for emissions exceeding four pounds per hour, removal efficiency at the air pollution control device shall be a minimum of 99%. Particulate matter must not exceed 0.08 grains per dry standard cubic foot, when corrected for the amount of oxygen in the stack gas.

7.2 Proof of Process Performance Testing Frequency for Units Treating Contaminated Media

Proof of process performance testing shall consist of three runs for each condition. For semi-volatiles, compositing of periodic grab samples consistent with the process is acceptable. There shall be a minimum of one soil/media composite sample per each test run. Special consideration is required for volatile organics sampling. When appropriate, volatile samples shall be collected using specialized sampling techniques (see Section 4.2) to minimize loss of volatile contaminants.

7.3 Emissions Monitoring - Stack Testing

Stack testing is part of POP Testing as specified in Section 7.1 above. Stack testing is required for a new unit or if new equipment is added to a previously tested unit; however, it is not needed each time an approved unit is set up and operated in a manner which is shown to be similar to previous test runs. Stack testing is required each time a new type of waste is being treated.

Initial stack testing parameters shall include:

- constituents of concern[11]
- hydrochloric acid (if applicable)
- other acid gas (if applicable)
- total hydrocarbons
- particulates
- visible emissions
- carbon monoxide
- oxygen
- applicable metals
- products of incomplete combustion/degradation, reaction, oxidation products

[11] Constituents of concern are constituents present in the soil or media prior to treatment.

(e.g., dioxins, dibenzo furans)[12]

Sites with soils having elevated background or metals from other sources shall undergo risk screening for metals emission. This is especially important when chlorinated compounds are also present in the untreated waste stream, as the presence of chlorine may result in metal volatilization at lower temperatures than anticipated.

In this case, samples representing the highest concentration of metals shall be collected from the site for the screening. See section 1.4 for additional notes on special conditions for dioxins/furans.

7.4 Emission Monitoring - Continuous Emission Monitors (CEM)

In keeping with the US EPA recommendations presented in the draft Superfund Remedy Implementation Guide, CEMs shall include:

- oxygen
- carbon monoxide
- total hydrocarbons
- carbon dioxide

Other parameters may be required on a case by case basis, based on the design of the unit. For carbon absorption units with duplicate carbon, breakthrough monitoring is required.

7.5 Sampling and Analytical Methods

Stack testing methodologies shall be as specified in 40 CFR Part 60, Appendices A and B, or SW846.

[12] If precursors of dioxins and furans such as chlorinated aromatics exist in the feed stream, sampling may be required. Sampling during performance tests should not be required continually. However, if the potential for presence of dibenzofurans is high, additional sampling may be necessary.

7.6 Sample QA/QC

All QA/QC required by each stack sampling or analytical method shall be completed. Lab QA/QC summary documentation (including chain of custody and summary of any deviation from the QA/QC specified by the method) shall be submitted with analytical results. Ultimate responsibility for QA/QC documentation belongs with the responsible party. However, the responsible party may contract with another entity, such as an analytical laboratory, to house the actual QA/QC data.

8.0 WATER DISCHARGE REQUIREMENTS

The operation of some treatment equipment may generate various types of water. Possible sources of water generation include condensate from the treatment system, storm water runoff, noncontact cooling water and soil stockpile leachate. All such water shall be collected; such water shall be treated, recycled or discharged in accordance with applicable regulations. If process water is used to remoisturize soil, treatment verification sampling shall occur after remoisturization. Any excess water which is generated shall be disposed in accordance with individual state requirements. In general, water can be disposed at a permitted off-site commercial facility, a publicly owned treatment works (POTW) or on-site in accordance with a National Pollution Discharge Elimination System (NPDES) permit.

9.0 OPERATIONS RECORD KEEPING

The following records shall be maintained on site or at other approved location:

- summary of waste treatment verification sample results;

- operating logs including
  CEM records or logs,
  shutdown events included in Section 6.4,
  monitoring parameters included in Section 6.3; and

- documentation on the retreatment or disposal of failed batches.

10.0 GENERAL QA/QC

An independent certified laboratory is required for all analytical testing for environmental media including air, soil and water. An in-house certified laboratory may be used if at least 10% of the samples are verified by an independent certified laboratory. These provisions apply to both mobile and fixed laboratories.

11.0 HEALTH AND SAFETY REQUIREMENTS

A written Health and Safety Plan shall be developed and implemented in accordance with Occupation Safety and Health Administration (OSHA) regulations 20 CFR 1910.120, the Hazardous Waste Operations and Emergency Response Rule.

The plan shall address the following elements:

Key Personnel	Air Monitoring
Health and Safety Risks	Site Control
Training	Decontamination
Protective Equipment	Emergency Response
Medical Surveillance	Confined Space Entry
Spill Containment	System Operation Safety
System Maintenance Safety	

12.0 CONCLUDING REMARKS AND PROCESS FINDINGS

12.1 Overview

Thermal desorption is a treatment technology which is designed to remove contaminants from solid media (e.g., soils, combustible solids) by volatilizing them with heat in the primary chamber, but without combustion of the media or contaminants. However, incidental combustion may occur in some primary thermal desorption units. The desorbed contaminants are then treated in the secondary unit to control air emissions. Some configurations of this technology destroy the contaminants with an afterburner or other thermal device. Other configurations collect the contaminants for later treatment using condensation and carbon adsorbtion, etc. Thermal desorption has been widely used in treating petroleum contaminated wastes and is being used increasingly in the cleanup of solid media, notably those containing hazardous chlorinated solvents, chlorinated pesticides, and polychlorinated biphenyls.

Goals of the Low Temperature Thermal Desorption (LTTD) Work Team were:

- to produce a standard set of technical requirements which could serve as a model to allow thermal desorption technology to move from state to state, without unnecessary redevelopment of technical requirements;

- to improve market conditions for thermal desorption technology providers by providing a degree of consistency and predictability in technical requirements for implementation of the technology for cleanup;

- to develop a viable, repeatable process for interstate cooperation directed toward enhancing implementation of innovative technologies and innovative application of existing technologies to site cleanup;

- to provide a framework for states which have no specific regulatory requirements for thermal desorption should they choose to develop those requirements and to provide a gauge for states which do have requirements to assess those requirements in light of the common requirements of other states;
- to provide a template of technical requirements which could be used as a model for other technologies for all functions presented above.

12.2 Approach

During a previous effort, the LTTD Work Team developed a document which blends diverse state technical requirements for a proven technology, low temperature thermal desorption, used for treatment of nonhazardous soils. The LTTD Work Team considered requirements from nine states to develop their draft document and circulated the document for review and comment to all member states of the Interstate Technology Regulatory Cooperation (ITRC) Work Group.

The LTTD group used its first document as a template for the second document, greatly reducing the time required to produce the subsequent document. The second document deals with solid media contaminated with hazardous chlorinated compounds such as polychlorinated biphenyls (PCBs), chlorinated solvents, and pesticides and addresses the associated broader range of temperatures for thermal desorption treatment. Requirements for chlorinated organics have been "layered" onto the original text to address some of the more complex issues of treating hazardous wastes. The LTTD Work Team uses the term "hazardous" as it is defined by the Resource Conservation and Recovery Act (RCRA), but also includes Toxic Substances Control Act (TSCA) regulated PCBs.

The work team designed this document to summarize the technical information and procedures necessary to demonstrate the operating capabilities of the thermal desorption unit. This document is not designed to summarize or interpret existing state or federal regulations.

12.3 Process

The LTTD Work Team members continue to operate in the mode which they found to be successful for their first effort. The team developed the draft document during facilitated conference calls and breakout sessions at full ITRC meetings. The following lessons learned from the initial efforts are being incorporated into the team's current work:

- The natural tendency for participants to focus almost exclusively in their areas of interest was taken into account when the team began its efforts for the hazardous waste document. The group has been expanded to include representatives from additional states, industry and the

United States Department of Energy which have an interest and expertise in hazardous waste issues.

• The LTTD group realized greatest efficiency in having a core group of experienced people from different states produce the draft product and then distribute the product to the full ITRC for final review.

• The LTTD group found it helpful to use a facilitator to keep their discussions focused and to perform the actual document revision and production work.

• The iterative process worked well for the LTTD group for their first revisions, because the individual group members were willing and able to invest the effort needed to follow-up with their colleagues.

12.4 ITRC Acceptance of the LTTD Work Product

In order to make the work products as useful as possible, the ITRC members have developed a process for member states to indicate their level of acceptance and intent to use these work products. When a work product, such as the thermal desorption regulatory requirements document, has been finalized by the work team, it is then distributed to the ITRC point of contact (POC) for each member state. The state POCs take the documents back to their home states and distribute copies to the various heads of their regulatory agencies. States are asked to provide letters documenting the level of acceptance they can apply to each work product. "Acceptance" of the work product is defined by each state.

The LTTD group has devised an approval checklist to be distributed with each document. This checklist allows an agency or division to indicate approval of each section of their document at the following levels:

Level A - We agree that the requirements are appropriate and commit to using them to the maximum extent feasible.
Level B - We agree that the requirements are appropriate; however, we have an organizational, regulatory, policy, or statutory conflict. (Please indicate what the conflict is).
Level C - We agree conceptually with the requirements and will consider using them in a test mode.
Level D - We do not believe the requirements are appropriate. (Please indicate the reasons why.)

Once letters of concurence and the approval checklists for this LTTD Work Team work product are received from the ITRC states, the results will be summarized in table format shown in Table D-1 of Appendix D.

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APPENDICES

APPENDIX A

ACRONYMS

APC	Air Pollution control
ARAR	Applicable or Relevant and Appropriate Requirement
ASTM	American Society of Testing and Materials
BNA	Base/Neutral/Acid
CAMU	Corrective Action Management Unit
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CEM	Continuous Emissions Monitor
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
CO	Carbon Monoxide
DCA	Dichloroethane
DCE	Dichloroethene
EPA	Environmental Protection Agency
GC/ECD	Gas Chromatograph/Electron Capture Detector
GC/MS	Gas Chromatograph/Mass Spectrometer
ITRC	Interstate Technology Regulatory Cooperation (Work Group)
LEL	Lower Explosive Limit
LTTD	Low Temperature Thermal Desorption
NPL	National Priority List
OSHA	Occupational Safety and Health Administration
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PCE	Perchloroethylene
PIC	Products of Incomplete Combustion
POC	Point of Contact
POP	Proof of Process
POTW	Publicly Owned Treatment Works
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation and Recovery Act
TCE	Trichloroethylene
TDU	Thermal Desorption Unit
TPHC	Total Petroleum Hydrocarbons
TRPH	Total Recoverable Petroleum Hydrocarbons
TSD	Treatment, Storage and Disposal
VO	Volatile Organic
VOC	Volatile Organic Compound
TSCA	Toxic Substances Control Act

APPENDIX B

ITRC Work Team Contacts
ITRC Fact Sheet
Product Information
User Survey

ITRC LTTD WORK TEAM CONTACTS

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APPENDIX C

SUGGESTED OUTLINE of
COST and PERFORMANCE REPORT
for THERMAL DESORPTION

1. Executive summary

2. Site information

3. Background
 a. Contaminant Location and Geologic Profile
 b. Contaminant Characterization
 c. Soil/waste characteristics affecting treatment cost or performance

4. Treatment System Description
 a. Thermal desorption system description and operation
 - Detailed Description
 - Automatic Feed-Cutoff Conditions
 b. Operating parameters affecting treatment cost or performance
 c. Project timeline

5. Treatment System Performance
 a. - Cleanup Goals/Standards
 b. - Treatment Performance Data
 - Test Run Data Summary
 - Full-scale Sustained Run Data Summary
 c. - Performance Data Assessment
 d. - Performance Data Completeness
 e. - Performance Data Quality

6. Treatment System Costs
 a. - Procurement Process
 b. - Cost Data Quality
 c. - Treatment Cost Elements
 d. - Before Treatment Cost Elements
 e. - Post Treatment Cost Element

7. Observations and Lessons Learned
 a. Cost Observations and Lessons Learned
 b. Performance Observations and Lessons Learned

8. References

9. Appendices

 A. Treatability Study Results (if applicable)
 - Objectives
 - Test Description
 - Performance Data

- Lessons Learned
- Full Scale Treatment Activity (soil data)

B. Test Run Data

C. Full Scale Treatment Activity Soil Data

APPENDIX D

Summary of
State Acceptance of
Thermal Desorption Work Product
Example Table

TABLE D-1
Summary of Verbal/Written Indications of State Concurrence
as of ________

Level A - We agree that the requirements are appropriate and commit to using them to the maximum extent feasible;
Level B - We agree that the requirements are appropriate; however, we have an organizational, regulatory, policy,
or statutory conflict. (Please indicate what the conflict is).
Level C - We agree conceptually with the requirements and will consider using them in a test mode; or
Level D - We do not believe the requirements are appropriate. (Please indicate the reasons why.)

STATE	Total Document "Level A"	Air Quality "Level B" All Others - "Level A"	Mixed for specified sections	Total Document "Level B"	Total Document "Level C"	Nonconcurrence for one or more sections "Level D"	Status of concurrence process
CA							
CO							
CO (UST)							
DE							
FL							
ID (?)							
IL							
KS							
KY							
LA							
MA							
MD							
NE							
NJ							
NM							
NY							
OH							
OR							
PA							
SC (?)							
SD							
TN							
TX							
UT (UST)							
UT (AIR)							
VA							
WA							
WI							